

FORM PTO-1390 (Modified) (REV 11-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER (E) 1689 PCT/US	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR <div style="font-size: 1.5em; font-weight: bold;">09/868996</div>	
INTERNATIONAL APPLICATION NO. PCT/EP99/09950		INTERNATIONAL FILING DATE 12/15/1999		PRIORITY DATE CLAIMED 12/22/1999, 1998	
TITLE OF INVENTION Fuel Metering Pump of a Heating Equipment, Particularly Water or Air Heating Equipment of a Motor Vehicle, With Control Equipment					
APPLICANT(S) FOR DO/EO/US Blaschke et al <i>BLASCHKE, Walter</i>					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below. 4. <input type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2)) <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). UNEXECUTED 10. <input checked="" type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)). 11. <input checked="" type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409). 12. <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210). 					
Items 13 to 20 below concern document(s) or information included:					
<ol style="list-style-type: none"> 13. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 14. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 15. <input checked="" type="checkbox"/> A FIRST preliminary amendment. 16. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 17. <input checked="" type="checkbox"/> A substitute specification. 18. <input type="checkbox"/> A change of power of attorney and/or address letter. 19. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825. 20. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4). 21. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). 22. <input checked="" type="checkbox"/> Certificate of Mailing by Express Mail 23. <input checked="" type="checkbox"/> Other items or information: 					
General Authorization to Charge Fees 1 Sheet - Formal Drawing					

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.53(a)(2))		INTERNATIONAL APPLICATION NO.		ATTORNEY'S DOCKET NUMBER	
09/868996		PCT/EP99/09950		(E) 1689 PCT/US	
24. The following fees are submitted:				CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :					
<input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO				\$1000.00	
<input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO				\$860.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO				\$710.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)				\$690.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)				\$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				\$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	14 - 20 =	0	x \$18.00	\$0.00	
Independent claims	1 - 3 =	0	x \$80.00	\$0.00	
Multiple Dependent Claims (check if applicable).			<input type="checkbox"/>	\$0.00	
TOTAL OF ABOVE CALCULATIONS =				\$860.00	
<input type="checkbox"/> Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				\$0.00	
SUBTOTAL =				\$860.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).				\$0.00	
TOTAL NATIONAL FEE =				\$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).			<input type="checkbox"/>	\$0.00	
TOTAL FEES ENCLOSED =				\$860.00	
				Amount to be: refunded	\$
				charged	\$
a. <input type="checkbox"/> A check in the amount of _____ to cover the above fees is enclosed.					
b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.					
c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>11-0665</u> A duplicate copy of this sheet is enclosed.					
d. <input checked="" type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO:					
M. Robert Kestenbaum 11011 Bermuda Dunes NE Albuquerque, NM USA 87111 Phone (505) 323-0771 Fax (505) 323-0865					
M. Robert Kestenbaum 20,430 June 20, 2001					

09868996 02107002
097 868996

JC18 Rec'd PCT/PTO 2 0 JUN 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re: International Application PCT/EP99/09950
Filed December 15, 1999
Title Fuel Metering Pump of a Heating Equipment, Particularly Water or Air
Heating Equipment of a Motor Vehicle, With Control Equipment
Applicant Blaschke et al
Attorney Docket (E) 1689 PCT/US

Box PCT
Commissioner for Patents
Washington, DC 20231

Preliminary Amendment

Dear Sir or Madam:

Please amend the above-identified application as follows:

In the Specification:

Enclosed, please find a substitute specification for use with this application.

Attached hereto is a version with markings to show changes made in this Amendment.

In the Claims:

Please cancel claims 1 to 7 and insert the attached new claims 8 to 17.

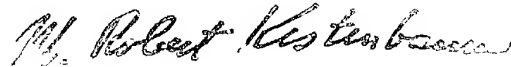
In the Abstract:

An Abstract of the Disclosure is attached hereto.

Remarks

This Preliminary Amendment conforms the application text to US style and practice. It also removes multiple dependencies in the claims. Please calculate the Filing Fee according to this Preliminary Amendment.

Respectfully submitted,



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Patent claims:

8. An electrically operated fuel metering pump of a heating equipment comprising a control equipment for a drive of the fuel metering pump and if necessary of the heating equipment, wherein hydraulic/pneumatic states (Z) and parameters (F, N) of a fuel medium are detected in a signal detector by electrical behavior of the fuel metering pump, and are evaluated in the control equipment for control of the metering pump and if necessary of the heating equipment.
9. The fuel metering pump according to claim 8, wherein the heating equipment comprises water heating equipment in the form of booster heater or standstill heater of a motor vehicle.
10. The fuel metering pump according to claim 8, wherein the heating equipment comprises at least one of a fan motor and an ignition device.
11. The fuel metering pump according to claim 8, wherein the drive for the fuel metering pump includes an electric motor or an electromagnetic coil with an armature and pump piston as a medium forwarder, and electrical behavior is detected as of a characteristic course of a motor signal or coil current signal.
12. The fuel metering pump according to claim 11, wherein the characteristic course of the signal is distinguished by a characteristic slope of at least one

of a rising flank (F) and a characteristic level or plateau associated with at least one of a solid or liquid pumping medium and viscosity of a pumping medium.

13. The fuel metering pump according to claim 12, wherein a set of medium parameters (K) is laid down in the control equipment.
14. The fuel metering pump according to claim 13, wherein the set of medium parameters (K) includes a set of temperature slope parameters.
15. The fuel metering pump according to claim 4, wherein the set of medium parameters (K) is designed for at least one of diesel fuel and PME as the medium.
16. A process for control of a heating equipment with an electrically operated fuel metering pump, particularly of a water heating equipment in a form of a booster heater or standstill heater of a motor vehicle, with a control equipment for a drive of the fuel metering pump and if necessary of the heating equipment, according to claim 8, comprising the steps of:
detecting hydraulic/pneumatic states (Z) and parameters (F, N) of a fuel medium in a signal detector of the control equipment by electrical behavior of the fuel metering pump, and

evaluating the states and parameters in the control equipment, in which medium parameters (K) and heating equipment parameters (P), are laid down, for detection of the medium.

17. The process according to claim 16, further comprising using the states and parameters of the fuel medium in the control equipment for at least one of adjustment or corrective drive of the fuel metering pump, a fan motor, an ignition device and parameters of the heating equipment.

[WO 00/37855]

PCT/EP99/09950]

“Version with Markings to show Changes Made”[Fuel Metering Pump of a Heating Equipment, ParticularlyWater or Air Heating Equipment of a Motor Vehicle, With Control Equipment]**Fuel Metering Pump of a Heating Equipment, Particularly Water or Air****Heating Equipment of a Motor Vehicle, With Control Equipment**Cross-References to Related ApplicationsNot applicable.Statement Regarding Federally Sponsored Research or DevelopmentNot applicable.Background of the Invention

[0001] The invention relates to an electrically operated fuel metering pump of a heating equipment, particularly a water heating equipment in the form of booster heating means or standstill heating means of a motor vehicle, with a control equipment for the metering pump drive and if necessary for the heating equipment, and also a process for the control of said heating equipment with an electrically operated fuel pump.

Technical Background

[0002] For the operation of independent heating equipments in a motor

vehicle, metering pumps are usually used for atmospheric vaporizer burners.

[0003] For the reliable starting and operation of the heating equipment, all the components are as a rule monitored by the control equipment. The control equipment usually has a high performance microprocessor. The microprocessor monitors the components to be driven, such as glow plug, burner motor, sensors, and metering pump, for interruption and short-circuit. As a rule, most equipments have a rotation speed control or voltage control.

[0004] Thus it can be assumed, with normally functional and correctly designed components, that all components fulfill their function for a reliable start and also heating operation.

[0005] This means, in detail:

[0006] The burner motor rotates, and thus combustion air is present;

[0007] The glow pin has no short-circuit and no interruption. Thus an intact glow pin can be assumed.

[0008] The fuel metering pump has no short-circuit and no interruption, and thus is in order electrically.

[0009] However it cannot be known whether the metering pump also supplies fuel. This means that the hydraulic state is unknown. Thus in the case of a failure to start or a cessation of normal operation, no opinion is possible as

to whether there was a lack of fuel or which medium is forwarded at the moment.

Summary of the Invention

[0010] The invention has as its object to provide an electrically operated fuel metering pump, together with control equipment, of the kind mentioned at the beginning, in which by means of simple and reliable measures (besides the electrical operation) a further monitoring and control takes place.

[0011] The object of the invention is attained by an electrically operated fuel metering pump of a heating equipment or a standstill heater of a motor vehicle, comprising a control equipment for a drive of the fuel metering pump and if necessary of the heating equipment, wherein hydraulic/pneumatic states and parameters of a fuel medium are detected in a signal detector by electrical control equipment for control of the metering pump and if necessary of the heating equipment.

[The subject of the invention is advantageously developed by the features of claims 2-7.]

[0012] The invention is applied as an auxiliary or booster heater to provide additional heating when the diesel engine doesn't warm up enough to combat the outside cold, and an auxiliary heater that is used while the car is stationary,

to warm it up and make it comfortable before driving it.

[0013] [The essence of the invention is that] [h]Hydraulic/pneumatic states and parameters of the fuel are detected in a signal detector by means of the electrical behavior of the fuel metering pump, and are evaluated in the control equipment for the control of the metering pump and/or of the heating equipment, particularly of the fan motor and/or the ignition device of the heating equipment.

[0014] [Preferably] [t]The metering pump includes an electric motor as drive means or an electromagnetic coil with armature and pump piston as the medium forwarding means, the electrical behavior being detected in the form of a characteristic course of the motor or coil current signal.

[0015] The course of the signal is in particular distinguished by a characteristic slope of the rising flank and/or a characteristic level or plateau, which is/are associated with a solid or liquid pumping medium and/or the viscosity of a pumping medium (gas/air, fuel, oil).

[0016] For an evaluation of an actual current signal with respect to a pumping medium in the fuel metering pump, a significant set of medium parameters is laid down in the control equipment, and [preferably] includes a set of temperature slope parameters and is in particular designed for diesel fuel

and/or PME as the medium.

[0017] A process according to the invention for the control of a heating equipment with a fuel metering pump thus in particular provides that hydraulic/pneumatic states and parameters of the fuel medium are detected in a signal detector of the control equipment by means of the electrical behavior of the fuel metering pump, particularly by means of the course of the current, and are evaluated in the control equipment, in which medium parameters and heating equipment parameters, particularly ignition parameters, are laid down, for [a] detection of the medium, and are in particular used for an adjustment or corrective drive of the metering pump and/or an adjustment or a corrective drive of the fan motor and/or an adjustment or corrective drive of the ignition device or adjustment of the ignition parameters of the heating equipment.

[0018] The metering pump includes in particular a coil, which upon application of a voltage produces a magnetic field, which attracts the pump piston and thus initiates the forwarding stroke. Since there exists a density difference with a factor of about 700 between air and e.g. diesel fuel, this becomes apparent in the coil current, as has been found by tests with an oscilloscope. A typical course of the signal is formed when air is forwarded, and also a typical course of the signal when a liquid is forwarded.

[0019] It is thus possible to distinguish between the gas medium (air) and the liquid medium (fuel), by means of the characteristic course of the signal.

[0020] It is furthermore possible to ascertain viscosity differences. Since the piston movement is strongly throttled in the case of liquids of high viscosity, the slope of the rising flank of the signal course, and also its level, are altered.

[0021] Since the viscosity depends on the kind of medium (air, fuel, oil), and also on the temperature, it is possible to determine the medium at present being used by means of a set of temperature slope characteristics laid down in the control equipment.

[0022] The evaluation of the slope change can take place similarly to, or the same as, a trend evaluation for flame detection. Since other preheater and stabilization times are applicable for diesel and PME (vegetable methyl ester, or "biodiesel") when starting the heating equipment, the control equipment parameters can be adjusted when, for example, the medium detection detects PME.

[0023] In particular, an evaluation is possible when the viscosity of the media differs strongly at the same temperature.

[0024] Thus it is basically possible to detect the hydraulic states and parameters by means of the electrical behavior (course of the current signal) of

the metering pump. This makes possible different start routines, and also a differentiated fault detection (e.g., exceeding the safety time due to lack of fuel can be excluded), an accelerated forwarding by the metering pump when air is detected (e.g., when first putting into service), and also a differentiation between diesel and PME, and thus an adjustment of the ignition parameters.

[0025] As a result, a heating operation of the heating equipment which is improved over the prior art, and in particular is more reliable, is thus possible by means of the invention. A single control equipment is sufficient for PME and diesel fuel.

Brief Description of the Drawings

[0026] The invention is described in detail hereinbelow using a circuit diagram showing the principle of a heating equipment in the form of an auxiliary heating equipment with metering pump and control equipment.

[0027] According to the drawing, the motor vehicle heating equipment 1 includes (among other things) a fuel metering pump 2, a fan motor 3, and an ignition device 4 which are driven in a known manner via a control equipment 5 by means of control devices 7, 8 or 9.

[0028] The fuel metering pump 2 has an electromagnet coil which is supplied with current 13 through the control device 7 of the control equipment 5, and on

the application of a voltage produces a magnetic field which attracts the pump piston and thus initiates the forwarding stroke.

[0029] Here the invention is stated:

[0030] The hydraulic/pneumatic state Z and parameters of the fuel medium are detected in a signal detector 6 by means of the electrical behavior of the fuel metering pump 2, and are evaluated in the control equipment 5 for a control, not only of the metering pump 2, but also of the whole heating equipment 1, in particular also of the fan motor 3 and of the ignition device 4.

[0031] The electrical behavior is detected here in the form of a characteristic course of the signal of the coil current 13.

[0032] The course of the signal is characterized, in particular, by a characteristic slope of the rising flank F and of the level N, which is/are associated with a solid or liquid pumping medium.

[0033] If a liquid medium is present, the temperature T of the medium is determined in addition, and the viscosity of the pumping medium is also determined in an evaluation in the form of a bit pattern M1, e.g. for diesel fuel or PME, using a set of medium parameters K laid down in the control equipment 5, with a temperature rise detection.

[0034] The bit pattern M1 is then fed to the microprocessor 14 for an

adjustment of the heating equipment parameter P in order to carry out driving 10 of the metering pump 2 via the control device 7, driving 11 of the fan motor 3 via the control device 8, and/or driving of the ignition device 4 via the control device 9.

[0035] If the evaluation logic of the signal detector 6 finds GAS as the medium, and if in particular a gaseous medium such as AIR is present, the bit pattern M2 for gas or air is fed to the microprocessor 14 for driving the metering pump 2, the fan motor 3, and/or the ignition device 4, corresponding to the gas or the air, in order to initiate, e.g., an accelerated forwarding by the metering pump 2 when air is detected.

[0036] [It should be remarked in addition that independently patentable features contained in the dependent claims are to have corresponding protection of their own, regardless of their formal relationship back to the main claim. In the remaining cases, all the inventive features contained in the whole application documents fall within the protective range of the invention].

EE/VHT 2. Auf.

11. Juli 2000 = 16.8.1997



PCT
WELTORGANISATION FÜR GEISTIGES EIGENTUM
Internationales Büro
INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE
INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

(51) Internationale Patentklassifikation ⁷ : F23N 5/20, F04B 49/06		A1	(11) Internationale Veröffentlichungsnummer: WO 00/37855 (43) Internationales Veröffentlichungsdatum: 29. Juni 2000 (29.06.00)
(21) Internationales Aktenzeichen: PCT/EP99/09950 (22) Internationales Anmeldedatum: 15. Dezember 1999 (15.12.99) (30) Prioritätsdaten: 198 59 319.8 22. Dezember 1998 (22.12.98) DE (71) Anmelder (für alle Bestimmungsstaaten ausser US): J. EBERSPACHER GMBH & CO. [DE/DE], Eberspächerstrasse 24, D-73730 Esslingen (DE). (72) Erfinder; und (75) Erfinder/Anmelder (nur für US): BLASCHKE, Walter [DE/DE], Am schönen Rain 83, D-73732 Esslingen (DE). EBERSPACH, Günter [DE/DE]; Seestrasse 9, D-72649 Wolfschlugen (DE). GÖTZ, Dieter [DE/DE]; Lenaustrasse 15/1, D-73230 Kirchheim (DE).		(81) Bestimmungsstaaten: CZ, DE, JP, US. Veröffentlicht Mit internationalem Recherchenbericht	
(54) Title: <u>FUEL DOSING PUMP OF A HEATING DEVICE, ESPECIALLY AN AUTOMOBILE WATER OR AIR HEATING DEVICE WITH A CONTROL DEVICE</u> (54) Bezeichnung: BRENNSTOFFDOSIERPUMPE EINES HEIZGERÄTS, INSBESONDERE WASSER- ODER LUFT-HEIZGERÄTS EINES KRAFTFAHRZEUGES, MIT STEUERGERÄT (57) Abstract The invention relates to an electric fuel dosing pump (2) of a heating device (1), especially a water heating device in the form of an auxiliary heater or an independent heating device of an automobile, having a control device (5) for controlling the dosing pump and optionally the heating device. The invention is characterized in that hydraulic/pneumatic states (Z) and parameters (F, N) of the fuel medium are detected in a signal detector (6) by means of the electrical behavior of the fuel dosing pump (2), especially the flow rate, and evaluated in said control device (5) for regulating the dosing pump (2) and optionally the heating device (1), especially also the fan motor (3) and the ignition device (4). Z...LIQUID			

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Blaschke et al
PCT/EP99/09950
Filed December 15, 1999
Attorney Docket (E) 1689 PCT/US

English Translation including English Translation of Annexes

1/PR15

WO 00/37855

PCT/EP99/09950

Fuel Metering Pump of a Heating Equipment, Particularly
Water or Air Heating Equipment of a Motor Vehicle, With Control
Equipment

The invention relates to an electrically operated fuel metering pump of a heating equipment, particularly a water heating equipment in the form of booster heating means or standstill heating means of a motor vehicle, with a control equipment for the metering pump drive and if necessary for the heating equipment, and also a process for the control of said heating equipment with an electrically operated fuel pump.

For the operation of independent heating equipments in a motor vehicle, metering pumps are usually used for atmospheric vaporizer burners.

For the reliable starting and operation of the heating equipment, all the components are as a rule monitored by the control equipment. The control equipment usually has a high performance microprocessor. The microprocessor monitors the components to be driven, such as glow plug,

burner motor, sensors, and metering pump, for interruption and short-circuit. As a rule, most equipments have a rotation speed control or voltage control.

Thus it can be assumed, with normally functional and correctly designed components, that all components fulfill their function for a reliable start and also heating operation.

This means, in detail:

- The burner motor rotates, and thus combustion air is present;
- The glow pin has no short-circuit and no interruption. Thus an intact glow pin can be assumed.
- The fuel metering pump has no short-circuit and no interruption, and thus is in order electrically.

However it cannot be known whether the metering pump also supplies fuel. This means that the hydraulic state is unknown. Thus in the case of a failure to start or a cessation of normal operation, no opinion is possible as to whether there was a lack of fuel or which medium is forwarded at the moment.

The invention has as its object to provide an electrically operated fuel metering pump, together with control equipment, of the kind mentioned at the beginning, in which by means of simple and reliable measures (besides

the electrical operation) a further monitoring and control takes place.

The object of the invention is attained by the means given in claim 1.

The subject of the invention is advantageously developed by the features of claims 2-7.

The essence of the invention is that hydraulic/pneumatic states and parameters of the fuel are detected in a signal detector by means of the electrical behavior of the fuel metering pump, and are evaluated in the control equipment for the control of the metering pump and/or of the heating equipment, particularly of the fan motor and/or the ignition device of the heating equipment.

Preferably the metering pump includes an electric motor as drive means or an electromagnetic coil with armature and pump piston as the medium forwarding means, the electrical behavior being detected in the form of a characteristic course of the motor or coil current signal.

The course of the signal is in particular distinguished by a characteristic slope of the rising flank and/or a characteristic level or plateau, which is/are associated with a solid or liquid pumping medium and/or the viscosity of a pumping medium (gas/air, fuel, oil).

For an evaluation of an actual current signal with respect to a pumping medium in the fuel metering pump, a significant set of medium

parameters is laid down in the control equipment, and preferably includes a set of temperature slope parameters and is in particular designed for diesel fuel and/or PME as the medium.

A process according to the invention for the control of a heating equipment with a fuel metering pump thus in particular provides that hydraulic/pneumatic states and parameters of the fuel medium are detected in a signal detector of the control equipment by means of the electrical behavior of the fuel metering pump, particularly by means of the course of the current, and are evaluated in the control equipment, in which medium parameters and heating equipment parameters, particularly ignition parameters, are laid down, for a detection of the medium, and are in particular used for an adjustment or corrective drive of the metering pump and/or an adjustment or a corrective drive of the fan motor and/or an adjustment or corrective drive of the ignition device or adjustment of the ignition parameters of the heating equipment.

The metering pump includes in particular a coil which upon application of a voltage produces a magnetic field which attracts the pump piston and thus initiates the forwarding stroke. Since there exists a density difference with a factor of about 700 between air and e.g. diesel fuel, this

becomes apparent in the coil current, as has been found by tests with an oscilloscope. A typical course of the signal is formed when air is forwarded, and also a typical course of the signal when a liquid is forwarded.

It is thus possible to distinguish between the gas medium (air) and the liquid medium (fuel), by means of the characteristic course of the signal.

It is furthermore possible to ascertain viscosity differences. Since the piston movement is strongly throttled in the case of liquids of high viscosity, the slope of the rising flank of the signal course, and also its level, are altered.

Since the viscosity depends on the kind of medium (air, fuel, oil), and also on the temperature, it is possible to determine the medium at present being used by means of a set of temperature slope characteristics laid down in the control equipment.

The evaluation of the slope change can take place similarly to, or the same as, a trend evaluation for flame detection. Since other preheater and stabilization times are applicable for diesel and PME (vegetable methyl ester, or "biodiesel") when starting the heating equipment, the control equipment parameters can be adjusted when, for example, the medium

detection detects PME.

In particular, an evaluation is possible when the viscosity of the media differs strongly at the same temperature.

Thus it is basically possible to detect the hydraulic states and parameters by means of the electrical behavior (course of the current signal) of the metering pump. This makes possible different start routines, and also a differentiated fault detection (e.g., exceeding the safety time due to lack of fuel can be excluded), an accelerated forwarding by the metering pump when air is detected (e.g., when first putting into service), and also a differentiation between diesel and PME, and thus an adjustment of the ignition parameters.

As a result, a heating operation of the heating equipment which is improved over the prior art, and in particular is more reliable, is thus possible by means of the invention. A single control equipment is sufficient for PME and diesel fuel.

The invention is described in detail hereinbelow using a circuit diagram showing the principle of a heating equipment in the form of an auxiliary heating equipment with metering pump and control equipment.

According to the drawing, the motor vehicle heating equipment 1 includes (among other things) a fuel metering pump 2, a fan motor 3, and

If a liquid medium is present, the temperature T of the medium is determined in addition, and the viscosity of the pumping medium is also

determined in an evaluation in the form of a bit pattern M1, e.g. for diesel fuel or PME, using a set of medium parameters K laid down in the control equipment 5, with a temperature rise detection.

The bit pattern M1 is then fed to the microprocessor 14 for an adjustment of the heating equipment parameter P in order to carry out driving 10 of the metering pump 2 via the control device 7, driving 11 of the fan motor 3 via the control device 8, and/or driving of the ignition device 4 via the control device 9.

If the evaluation logic of the signal detector 6 finds GAS as the medium, and if in particular a gaseous medium such as AIR is present, the bit pattern M2 for gas or air is fed to the microprocessor 14 for driving the metering pump 2, the fan motor 3, and/or the ignition device 4, corresponding to the gas or the air, in order to initiate, e.g., an accelerated forwarding by the metering pump 2 when air is detected.

It should be remarked in addition that independently patentable features contained in the dependent claims are to have corresponding protection of their own, regardless of their formal relationship back to the main claim. In the remaining cases, all the inventive features contained in the whole application documents fall within the protective range of the invention.

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PATENT CLAIMS (AMENDED)

1. Electrically operated fuel metering pump (2) of a heating equipment (1), particularly a water heating equipment in the form of booster heating means or standstill heating means of a motor vehicle, with a control equipment (5) for the drive of the metering pump and if necessary of the heating equipment,

wherein

hydraulic/pneumatic states (Z) and parameters (F, N) of the fuel medium are detected in a signal detector (6) by means of the electrical behavior of the fuel metering pump (2), and are evaluated in the control equipment (5) for the control of the metering pump (2) and if necessary of the heating equipment (1), particularly of the fan motor (3) and/or the ignition device (4).

2. Fuel metering pump according to claim 1, wherein the metering pump (2) includes as drive means an electric motor or an electromagnetic coil with armature and pump piston as the medium

forwarding means and the electrical behavior is detected in the form of a characteristic course of the motor signal or coil current signal.

3. Fuel metering pump according to claim 2, wherein the course of the signal is in particular distinguished by a characteristic slope of the rising flank (F) and/or a characteristic level (N) or plateau, which is/are associated with a solid or liquid pumping medium and/or the viscosity of a pumping medium (gas/air, fuel, oil).
4. Fuel metering pump according to claim 3, wherein a set of medium parameters (K) is laid down in the control equipment (5).
5. Fuel metering pump according to claim 4, wherein the set of medium parameters (K) includes a set of temperature slope parameters.
6. Fuel metering pump according to claim 4 or 5, wherein the set of medium parameters (K) is in particular designed for diesel fuel and/or PME as the medium.
7. Process for the control of a heating equipment with an electrically

operated fuel metering pump (2), particularly of a water heating equipment in the form of booster heating means or standstill heating means of a motor vehicle, with a control equipment (5) for the drive of the metering pump and if necessary of the heating equipment, according to one of claims 1-6, wherein

hydraulic/pneumatic states (Z) and parameters (F, N) of the fuel medium are detected in a signal detector (6) of the control equipment (5) by means of the electrical behavior of the fuel metering pump (2), particularly by means of the course of the current, and are evaluated in the control equipment (5), in which medium parameters (K) and heating equipment parameters (P), particularly ignition parameters, are laid down, for a detection of the medium, and are in particular used for an adjustment or corrective drive (10) of the metering pump (2) and/or an adjustment or corrective drive (11) of the fan motor (3) and/or a corrective drive (12) of the ignition device (4) or adjustment of the ignition parameters of the heating equipment (1).

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KEY TO THE FIGURE

Decision step Z: "liquid"

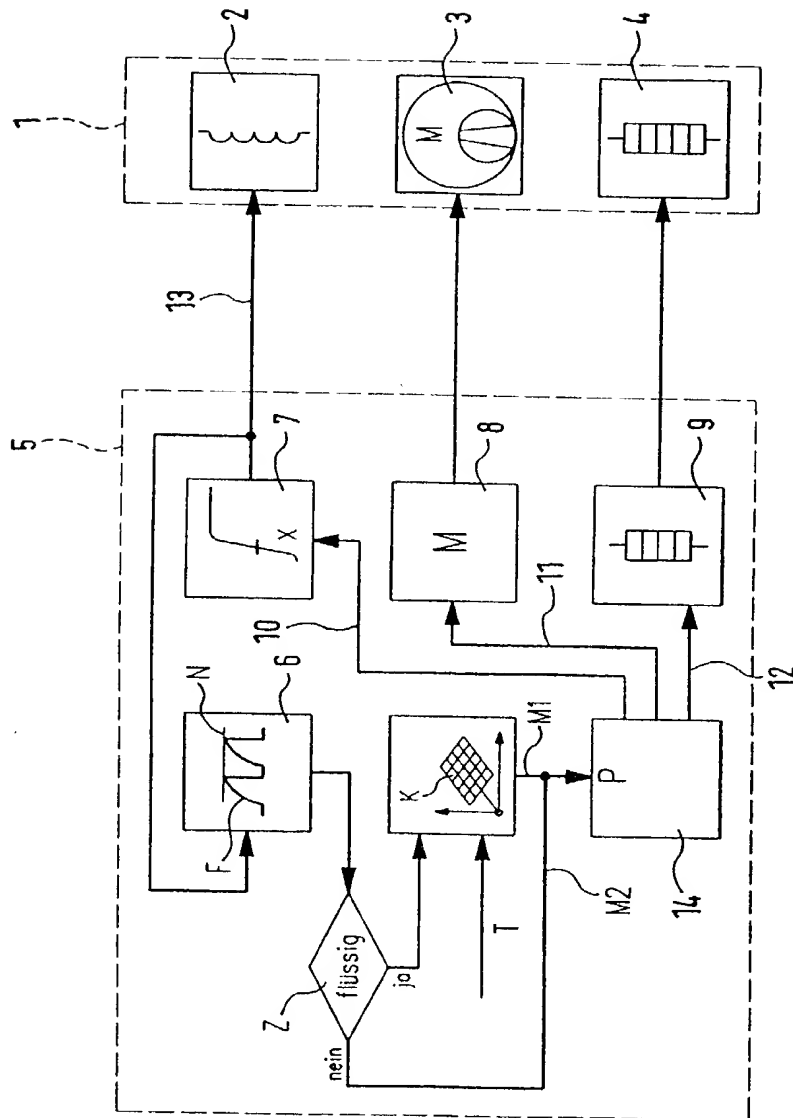
output M2: "nein" = "no"

output: "ja" = "yes".

Abstract of the Disclosure

An electric fuel metering pump of a heating device, especially a water heating device in the form of an auxiliary heater or an independent heating device of an automobile, has a control device for controlling the metering pump and optionally the heating device. Hydraulic/pneumatic states (Z) and parameters (F, N) of the fuel medium are detected in a signal detector by the electrical behavior of the fuel metering pump, especially the flow rate, and evaluated in the control device for regulating the metering pump and optionally the heating device, especially a fan motor and an ignition device.

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Docket No.
(E) 1689 PCT/US

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled
Fuel Metering Pump of a Heating Equipment, Particularly Water or Air Heating Equipment of a Motor Vehicle, With Control Equipment

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on December 15, 1999 as United States Application No. or PCT International Application Number PCT/EP99/09950 and was amended on _____

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed

198 59 319.8

(Number)

Germany

(Country)

22-12-98

15/12/1999

(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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